MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023 (TERM ID 2220)

ECP3266 – ARTIFICIAL INTELLIGENCE AND APPLICATIONS

(ME, RE)

03 JULY 2023
09:00 AM – 11:00 AM
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 pages excluding the cover page with **FIVE** questions only.

2. Attempt **ALL** questions. Distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

Question 1: [20 marks]

a) Briefly describe the main characteristics of the four industrial revolutions.

[12 marks]

b) In 2011, Germans first introduced "Industry 4.0". The term has been speedily adopted and become the most modern and most articulated buzzword across the manufacturing sector globally. Describe the 4th industrial revolution based on the idea of Klaus Schwab.

[4 marks]

c) By connecting cyber-physical systems into manufacturing technologies, Industry 4.0 creates manufacturing of the future known as the Smart Manufacturing. Describe the term smart manufacturing according to the National Institute of Standards and Technology (NIST) and highlight the technologies involved.

[4 marks]

Question 2: [20 marks]

a) Machine learning plays a critical role in automatic identification of whether a person is wearing face mask or not. Consider a scenario where you have a dataset that contains 2200 wearing mask and 500 not wearing mask facial images with the corresponding target output, Yes and No. You want to train a machine learning model to infer facial images into two groups: Yes or No.

i) Describe the word "**dataset**" which is underlined in the statement above.

[8 marks]

ii) Propose and describe what type of machine learning algorithm should be used to train the model for detecting if a person is wearing a mask or not.

[8 marks]

b) Which tasks are required for AI? Describe any FOUR tasks.

[4 marks]

Continued...

Question 3: [20 marks]

Felidae family have been split into three species as shown the Table Q (3).

Table Q3. Felidae family

Species	Examples
Panthera	lions, tigers, leopards, snow leopards, clouded leopards and jaguars
Acinonyx	cheetah
Felis	all other 'small' cats

Consider a machine learning model has been trained to solve classification of the Felidae family based on genetic investigations. The trained model infers whether the species of a genetic sample is Panthera, Acinonyx or Felis. 1000 genetic samples are used to verify the model performance. Among the 1000 samples, species in 400 samples are Panthera, species in 360 samples are Acinonyx and species in 240 images are Felis. The classification result of the model is that in the 400 samples, 240 species are Acinonyx and 80 species are Felis, while in the 360 samples, 120 species are Panthera and 0 species are Felis, while in the 240 samples, 40 species are Acinonyx and 40 species are Panthera.

i) Construct confusion matrix table.

[8 marks]

ii) Calculate precision and recall for each species classified by the model.

[12 marks]

Question 4: [20 marks]

a) Compare between the traditional machine learning and the deep learning using an architecture of each model.

[4 marks]

b) List the neural network terminology.

[3 marks]

c) Consider a perceptron with a bias and an activation function $g(z)$ that accepts input sample with three features.

i) Illustrate the architecture of this perceptron.

ii) Determine the expression of the predicted output y for the trained weights, $w_0 = 0.02$ and $W=\begin{bmatrix}-0.01\\0.03\\-0.20\end{bmatrix}$

iii) If sigmoid activation function $g(z)=\frac{1}{1+e^{-z}}$ is used, determine the predicted outputs $\hat{y}$ for inputs $X^{(1)}=[2\ 3\ 4]$ and $X^{(2)}=[-3\ -4\ 10]$.

[4+5+4 marks]

Continued...

Question 5: [20 marks]

a) Define activation function in the neural network. List some of commonly used activation functions.

[2+2 marks]

b) A deep neural network (DNN) has been trained with a training set to solve image classification of the Felidae family into three species, namely Panthera, which includes lions, tigers, leopards, snow leopards, clouded leopards and jaguars; Acinonyx, which includes cheetah; and Felis, which includes all other 'small' cats. The output layer of this DNN is shown in Figure Q5b.

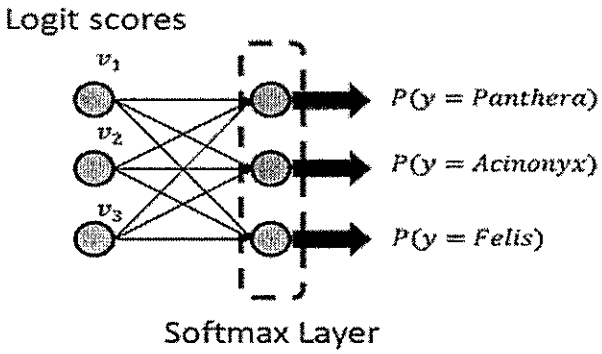

Figure Q5b

Consider an unknown image sample is input into this DNN and generates logit scores $\bar{v} = [3.0, 5.0, 0.4]$, determine the class of this input sample.

[8 marks]

c) Consider a feature map generated by convolution layer as shown in Figure Q5c. Determine the pooled output using average pooling with 2 x 2 filter and stride = 2.

[4 marks]

12	20	30	0
0	1	1	2
0	12	1	8
100	112	1	25

Figure Q5c

d) Highlight any TWO requirements for future employees in the era of emergence of Artificial Intelligence (AI).

[4 marks]

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